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Performance indicators at different organisational levels in manufacturing companies

Anna Landström¹, Peter Almström¹, Mats Winroth¹

¹Chalmers University of Technology, Department of Technology Management and Economics, Gothenburg, Sweden

anna.landstrom@chalmers.se

Abstract

The purpose of this article is to study how performance is measured at different organisational levels within manufacturing organizations. The analysis and discussion are based on the results from a present state analysis of 7 different Swedish manufacturing sites conducted in the research project “Sustainable and resource efficient business performance measurement system” which is a part of the Swedish research program Produktion2030. The indicators used at the sites were collected through interviews with managers on different levels in the organization and studies of the visualised performance indicators on score cards and on KPI boards.

To determine the differences between organizational levels, the performance indicators were categorized according to their type, topic, and frequency of updating the results.

The largest differences were found between site level and area level in all analyses. On site level there was a larger amount of indicators, lower frequency of updating the results, and more frequent use of advanced indicators. The focus on site level was more on financial indicators and the total amount of performance indicators are higher compared to area and work centre level.

This article contributes to the performance measurement systems body of knowledge through the identification of differences in type and topic of performance indicators used at different organisational levels within a manufacturing organization.

Keywords: Performance measurement system, Performance indicators, Organisational level.

1. Introduction

The performance measurement system has an import role in the management systems of today's companies [1] and is widely used within Swedish manufacturing companies. There is a lot of research within this area and it exists several multi-dimensional frameworks for performance measurement systems [2]. However, according to De Toni & Tonchia [3] there are few large empirical studies concerning models, characteristics and indicators.

Neely & Bourne [4] state that “the trick is to measure as little as possible, but to ensure that you are measuring the things that matter”. However, during the last decades a trend of increasing number of performance indicators used at companies have been observed [5]. The large amount of indicators requires more resources for measuring and analysing the data, and can lead to information overload which makes it hard to distinguish the important information from information with less values [6].

To rationalise and decrease the number of performance indicators it is important to know what and how to measure the performance on different organisational levels within an organisation. The importance of using appropriate measures at all levels of the organisation is agreed on within the performance measurement systems research field [7]. Neely et al. [8] state that it is important to recognise that the set of suitable measures varies between departments and sites. And as stated by Crawford & Cox [9] it is important that those whose performance is evaluated understand the indicators.

One important factor to ensure understanding is to use different types of indicators depending on the purpose. The simplest measure is an absolute value of a plain variable which has limited usefulness [10] since it is hard to use for benchmarking and comparing different units in case they varies in for example size. Ratios are more useful because they often are more easily understood when they are analysed

since they often visualise the results relative the target of the indicator [10].

Today only little research has been made on differences between performance indicators at different organizational levels within a manufacturing organisation.

This paper is a part of the research project “Sustainable and resource efficient business performance measurement systems” (SuRE BPMS) which is a part of Swedish Strategic Innovation program Produktion2030. The goals for the project are:

- Increased efficiency, and reduced cost for BPMS.
- Improved presentation of KPIs
- Clearer links between corporate strategy and BPMS.
- Integration of sustainability in corporate BPMS.
- More business processes integrated in the BPMS.

This paper will present the results from a present state study performed within the research project SuRE BPMS [11].

The purpose of this article is to study how performance is measured at different organisational levels in a manufacturing organisation. The analyses of the empirical data from the study in this paper focus on differences between the organisational levels regarding the number of performance indicators, the topic and type of performance indicators as well as the frequency of updating the results of the performance indicators. The results from the analysis will answer following research question:

- What are the differences in performance indicators used at different organisational levels?

The methodology used for data collection and analysis will be described in the next section followed by the results. Then the results will be discussed and finally a conclusion of the paper will be provided.

2. Methodology

2.1 Data collection method

The data collection method was based on the performance measurement record sheet [12] and adapted to fit the purpose of the present state study performed in the research project SuRE BPMS. The following information was gathered for each identified performance indicator:

- *Title* – The title of the indicator set by the company.
- *Explanation if needed* – Clarify the purpose of the indicator if needed.
- *Company topic* – how does the company categorize the indicator?
- *Formula/Definition* – What does the indicator measure? For a numerical indicator the formula for the calculation should be documented and for status indicators the different statuses should be documented.
- *Frequency* – How often is the result of the indicator documented and analyzed?
- *Who measure* – Who collects the data?
- *Who analyses* – Who analyses the data?
- *Visualization* – How is the result of the indicator presented?
- *Target* - Does the indicator have a target?
- *How is the indicator used?* – Is the indicator used for reporting, decision making or both?
- *Organizational level* - The organizational level categorization is based on ISO 22400-2:2014 [13] (see Fig. 1).

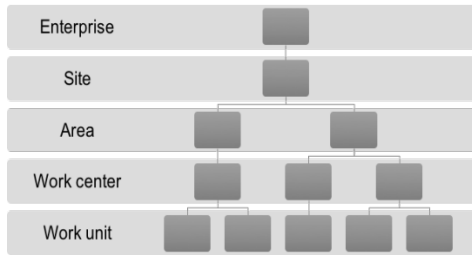


Fig. 1: Organizational levels

The data was collected through interviews with managers at different organisational levels and by studying the visualisation of performance indicators at meeting areas for production control and selected support functions. To increase the understanding of the use of performance indicators the researcher participated in a few production control meetings at different levels.

The data collection was limited to the manufacturing function and the support functions; quality, maintenance and internal logistics at each manufacturing site. Due to the limitations, the organizational levels Enterprise and Work unit were excluded from this study.

Empirical data was collected at 7 production sites located in Sweden. The selected sites are part of 6 large multinational companies (site F and G are from the same company) and has a similar set of manufacturing processes. The size of the sites varies between 270-1800 employees and there are both end products producers and component producers. Table 1 shows more detailed information about the companies. The companies were selected based on their interest in improving their performance measurement system and their participation in the research project SuRE BPMS.

Table 1: Information about the companies.

Site	No. of employees	Product	Manufacturing processes
Site A	1000	Machines and Tools	Machining, assembly
Site B	1200	Aero space components	Machining, welding, surface treatment, testing
Site C	270	Vehicle components	Machining, surface treatment, assembly
Site D	380	Machines and tools	Machining, heat treatment, assembly, surface treatment
Site E	1800	Machines	Machining, assembly
Site F	1000	Heavy vehicle	Machining, welding, painting, assembly
Site G	800	Heavy vehicle	Machining, welding, painting, assembly

2.2 Analysis method

The data has been analysed according to:

- The number of performance indicators
- The topic of the performance indicator
- The frequency of updating the result
- The type of performance indicator.

To be able to analyse and compare the amount of performance indicators at the different organisational levels the number of indicators were divided by the number of organisational units at the level.

To analyse which topics that were mostly measured within the different organisational levels, 12 categories of indicators were defined based on [14] and [5].

1. *Financial indicators* – Indicators measuring cost and other financial aspects of production.
2. *Human resource indicators* – Indicators related to employees and staffing.
3. *Research and development indicators* – Indicators measuring both larger development projects and continuous improvement work.
4. *Productivity indicators* – Indicators measuring the productivity and efficiency of the production processes.
5. *Quality indicators* – Indicators measuring the quality of the products and quality activities.
6. *Flexibility indicators* – Indicators measuring the flexibility in production processes.
7. *Delivery reliability indicators* – Indicators measuring the delivery quantity as well as the ability to deliver on time.
8. *Speed indicators* – Indicators measuring the lead time aspects of production processes.
9. *Equipment indicators* – Indicators measuring the availability of the equipment and maintenance issues.
10. *Supply chain indicators* – Indicators connected to suppliers and customers.

11. *Safety indicators* – Indicators measuring safety and safety improvement work.
12. *Environmental indicators* – Indicators measuring the environmental impact of production.

To analyse the frequency of updating the results for the performance indicators, the identified set of performance indicators were divided into:

- *More than daily* – the results were updated more than once a day
- *Daily* – the results were updated once a day
- *Weekly* – the results were updated once a week
- *Monthly* – the results were updated once a month
- *Less than monthly* – the results were updated less frequently than once a month.

To determine which type of performance indicator that are most common within the different organizational levels the identified indicators were divided into:

- *Rate* – comparison with different units, e.g. cost/unit
- *Ratio* – comparison with the same units, e.g. produced units/planned units
- *Absolute value* – the results was shown as a value of a plain variable
- *Status indicator* – This type of indicator shows only if the indicator is within the target value or if a task is performed or not. It is often visualized with a red, yellow or green indicator.

3. Results

In this section the results from the analyses will be presented. All results in this section are an average of the results from the different sites.

3.1 Performance measurement systems

All studied sites had a standardized production system which includes performance measurement through monthly score cards. Score card was used at site level at all 7 sites and area level at 4 sites. Only one site used score card on work centre level. The results in the score cards were mostly discussed during monthly meetings where more long term strategic decisions are taken.

At area and work centre level daily production control meetings were held at all sites and some of the sites also had daily meetings at site level. During these short meetings deviations from targets were discussed and actions to reach the targets were created. The agenda for the daily production control meetings are often set by the performance indicators used however, only 2 of the sites had standardized KPI boards for their daily production control. At the other sites the performance indicators visualised on the KPI board are set by the manager for the organisational unit.

3.1 Number on Performance indicators

It can be seen in fig. 2 that the average number of performance indicators per organisational unit decreases in the lower organisational levels. Site level had almost twice the number of performance indicators than area level had and the same relation applies for area and work centre level. In this analysis the variation between the different sites were quite low at area (standard deviation of 2,2) and work centre level (standard deviation of 6,7). The biggest reason for the slightly larger standard deviation at work centre level is the

use of scorecards hence a larger number of indicators, at one of the sites. On site level the variation is quite large, standard deviation of 27,4.

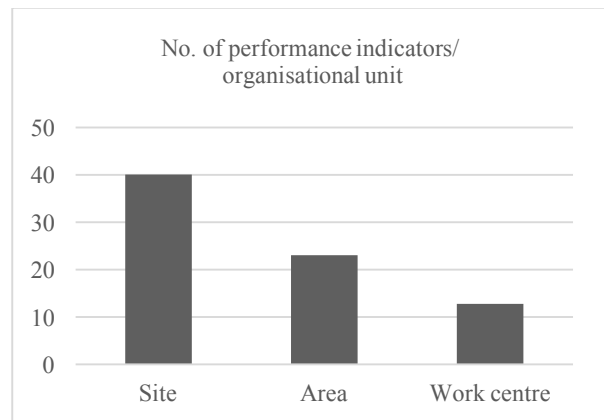


Fig 2: Average number of performance indicators per organisational unit for the different organisational levels.

3.2 Topics of indicators

The results from the analysis of indicator topics are presented in fig. 2. The figure shows the average distribution of the studied sites. The variation between sites are quite large, however the results gives an indication of the topics that were focused on at different organisational levels within the studied sites.

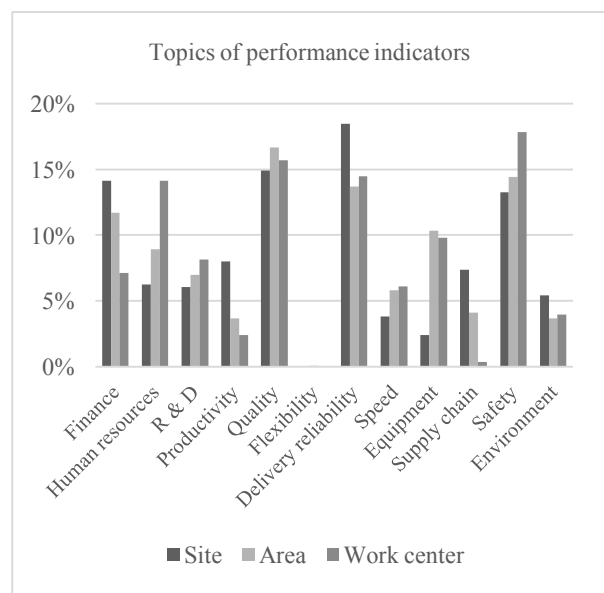


Fig. 3: Distribution of performance indicators between topics.

Table 2 shows the 3 most used and the 3 least used topics for the different organisational levels. It can be seen that area and work centre level had similar focus, however the biggest difference between them was that work centre level focused more on human resources than area level. Site level focus more on financial, productivity and supply chain measures than area and work centre level.

Table 2: Top3 and Bottom 3 topics for the different organisational levels.

	Site	Area	Work centre
Top 1	Delivery reliability	Quality	Safety
Top 2	Quality	Safety	Quality
Top 3	Finance	Delivery reliability	Delivery reliability
Bottom 1	Equipment	Environment	Supply chain
Bottom 2	Speed	Productivity	Productivity
Bottom 3	Environment	Supply chain	Environment

3.3 Frequency of updating the results of indicators

The use of monthly indicators is connected to the use of score cards since they were measured on a monthly basis at the studied sites. One of the sites used score cards on all levels which contributed to the unexpected large share of monthly indicators at work centre level. The reason for the big impact was that their score card was quite extensive compared to the amount of daily indicators. The use of score card increased in the higher organisational levels. It should also be mentioned that one site only used scorecards on area level and therefore only had monthly indicators. On site level only 3 sites used daily indicators which explains the low amount of daily indicators at site level.

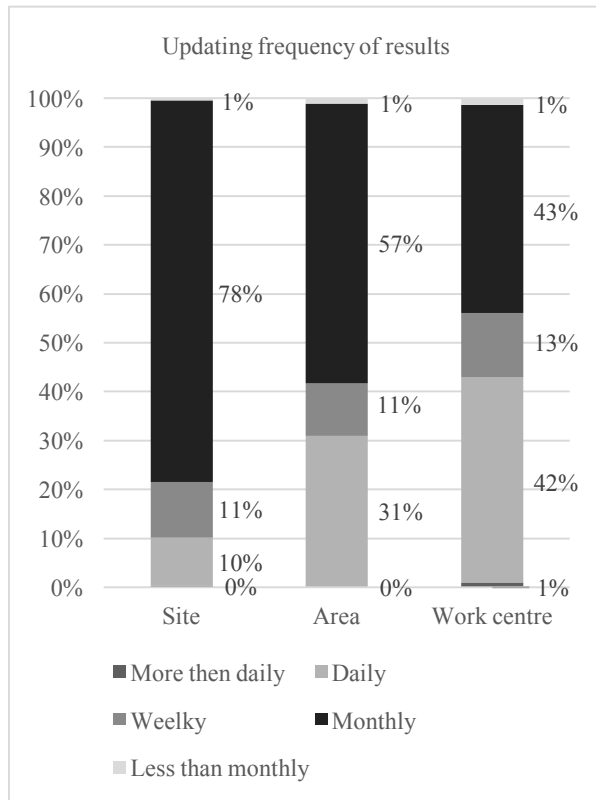


Fig. 4: Distribution of performance indicators between updating frequency of the results.

3.4 Type of indicator

The most used types of performance indicators were ratio and absolute value, see fig. 4. Work centre level had mostly absolute values and status indicators and only two of the sites used rates at this level. The most used rate on work centre level was cost/unit. Area level and work centre level used mostly absolute values, however area level used a larger share of rate and ratios and smaller share of status indicators. On site level approximately 50% of the indicators were ratios and only a very small share were status indicators. Rates were not frequently used in any of the organisational levels.

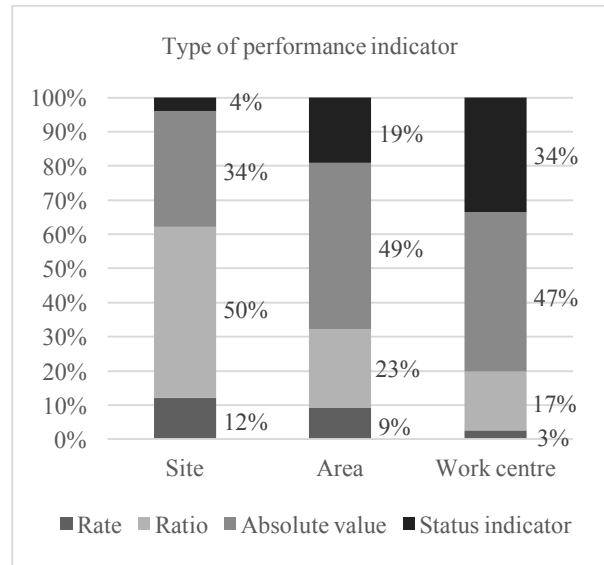


Fig. 5: Distribution of performance indicators between type of indicator.

4. Discussion

The main finding from the analysis was that the biggest differences were found between site and area level in the different analyses. One explanation of the results might be that on area and work centre level the main focus of performance measurement system was operational control while on site level the main focus was reporting to corporate management and benchmarking. Another factor that affects the results is that on site level the set of key performance indicators were mostly a corporate decision while on area and work centre level the design of performance indicators was made by the site management. Site level also included more functions such as sales and marketing, human resources and finance.

The number of performance indicators per organisational unit and the frequency of measure decreased at the lower organisational levels. This is probably also connected to the different purposes of the performance indicators. As stated in the introduction it is important to have few indicators to make sure to highlight the most important information. This makes it even more important to measure the right things since the chosen indicators set the agenda for the production control meetings in the studied companies at area and work centre level. Therefore, the amount of performance indicators also determines the time spent on production control meetings which in turn affects the productivity and cost of production.

On site level and to some extent on area level there might be a need for larger amount and more advanced indicators to get enough information to be able to make more long term strategic decisions.

The distribution between topics were quite similar for area and work centre level, they had the same top and bottom 3 but in different order. On site level there were some differences, more focus was spent on financial, supply chain and productivity measures and less focus on safety, speed and equipment measures. One of the reasons for the differences is the different focus and responsibilities in the organisational levels. Site level had more customer contact and financial responsibilities while area and work centre focused more on the safety for their employees and other prerequisites for an efficient production process.

The most used type of indicators at site level was ratio, which is according to [10] easy to understand when analysing the results. However on area and work centre level absolute value was most used which probably is related to the simplicity of the indicator [10]. One reason for this result might be the slightly different purposes for the indicators. On work centre level the indicators were mostly used to compare the performance by the targets set by the managers, while on site level the performance indicators were mostly used to make more long term analyses and plans. On area level indicators were used for both follow up the performance against targets on short term goals as well as making more long term analyses for their specific area.

It should be noted that Site E was a larger organisation with more employees than the other sites and therefore had 2 additional organisational levels. One additional organisational level between site and area which grouped the different production areas into an organisational unit called production. This level was included in the site level in the analysis. The other additional organisational level was found between area and work centre level and grouped similar work centres into sub-areas. These sub-areas were included into the area level in the analysis. It is also worth noticing that site C is not included in work centre level since there were no production control meetings or scorecards for the different work centres.

To increase the understanding of use of indicators at different organisational levels a more qualitative study could be conducted. This would increase the understanding of which type, topic and frequency of updating the indicators that are suitable for the different levels and functions.

The empirical data from the SuRE BPMS present state study were not complete and therefore only the performance indicators with available information for the specific analysis was included in the different analysis. This can have an effect on the results, however the missing performance indicators is quite few compared to the number of performance indicators with available data. The selection of included support function might also influence the results, for example if the marketing and sales function had been included the share of supply chain measures would probably be larger since they are responsible for the customer and supplier contact on area and work centre level.

It is important to note that there are more indicators at the sites which are not visualized during the production control meetings. These indicators are often found in computer systems and different reports e.g. environmental report. The delimitation of the present state analysis to exclude these

indicators affects the results and might be a reason for the low amount of rates and more advanced ratios as well as the distribution of indicators between the topics.

All data collection was performed under supervision of one person and therefore it was ensured that the data collection method was performed in the same way at all sites.

The generalisability of the results from this study is limited since the studied sites were not selected randomly. However, all sites are part of large multi-national companies, located in Sweden and has similar production systems which are influenced by lean and uses daily production control. Therefore, the results can be said to be valid for sites with similar characteristics.

5. Conclusion

The biggest differences in the use of performance indicators were identified to be between site level and area level. On site level there was a larger amount of indicators, lower frequency of updating the results, and more frequent use of advanced indicators. The focus on site level was more on financial indicators and the total amount of performance indicators are higher compared to area and work centre level.

One of the identified reasons for the differences between organisational levels was that they used the indicators for different purposes. To deepen the understanding of the underlying reasons for the results a more qualitative research needs to be conducted to identify the different stakeholders view on each level. The results from this study imply that there is a need for future research within performance indicators at different organisational levels to improve the design and use of performance measurement systems.

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